Insights

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Ontario Forest Research Institute
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Indicators - *Assessing Sustainability*

By David DeYoe, OFRI General Manager

Globally and locally forest resource owners, and associated stakeholders, are looking more intently at indicators to assess forest sustainability. This requires a clear sense of what constitutes sustainability for the ownership in question. No simple task!

An indicator, or mix of indicators, provides a means of quantifying forest activities in the context of their short or longer term effect on productivity, biodiversity, soil and water condition, or other criteria considered inherent to sustainability. The activities might include harvesting (animals or trees), recreation, rural development, mining, site conversion (farming), etc. The indicator must consider the type, intensity, duration, frequency and extent of the activity within a suitable spatial and temporal framework. This is the simple part. The difficulty arises in determining how the information fits together to actually provide a picture of sustainability across the ownership.

Scientists at OFRI are working with government, forest companies and private stakeholders to validate and develop indicators that meet ownership and stakeholder objectives. These efforts are designed to help OFRI customers achieve sustainability goals, whether legislated, required for acquisition of CSA or ISO certification, or personal. The product will be continuing development of information to improve decisions and implement sustainable practices - "upgrades" to our silvicultural tool kit for sustainability.

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In this issue . . .

Managing Ontario's Boreal Mixedwood Forest 1

Season and Height of Cutting Dictate Effectiveness 4

Northeast'Super' Trees, Super Fast..... 5

OFRI scientist wins Amethyst 6

Growth and Yield Modelling Toolkit Being Developed 7

Have a suggestion? 8

1990-1995 Annotated Bibliography 8

Upcoming Events 8

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Managing Ontario's Boreal Mixedwood Forest

By Jocelyn Watt

What is careful logging?
What is a FEC site type?
What is a successional pathway?

Any visitor to the Mixedwood Demonstration Area can answer these questions and more within a 45-minute walk along the self-guided trail. The 5-hectare site, located in the Lake Abitibi Model Forest just outside of Iroquois Falls, was designed by OFRI's Mixedwood Silviculture Program to give the general public an overview of forest research that is being conducted elsewhere on a larger scale. Signage on the trail allows walkers a first-hand look at how forest researchers are bringing northern Ontario's Boreal Mixedwood (BMW) forests closer to the goals of sustainability.

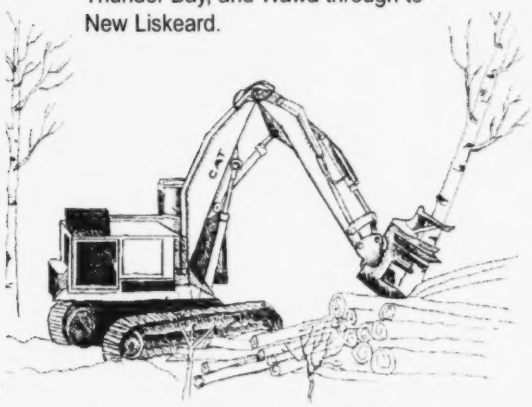
The demonstration area showcases research that is examining the ecosystem dynamics of Ontario's expansive Boreal Mixedwood Forest. The 20 tour stops illustrate how economical, modified harvesting systems are being developed to

(cont'd on page 2)

reduce ecosystem damage, to improve crop tree regeneration, and to enhance non-timber resource values. This research will lead to the production of Ontario's *Boreal Mixedwood Notes*, a set of guidelines designed to support MNR forest management policy and to help forest industry managers to build site-specific mixedwood strategies into their resource planning.

What is a Boreal Mixedwood Forest?

Ontario's Boreal Forest covers a vast portion of its northern landbase. Although largely coniferous, about 53% of Ontario's Boreal Forest Region consists of mixed species forest, representing approximately 15.8 million hectares of the Boreal zone's productive forest land. These forests can be found north of a line that runs from Kenora through Thunder Bay, and Wawa through to New Liskeard.



Careful Logging. A 'feller-buncher' removes the overstory trees without damaging understory conifers. The machine moves along 5-metre wide trails spaced 21 metres apart. Some trees are left standing at intervals along the trails to absorb damage from equipment.

Because mixedwood forests are highly diverse in their composition and dynamics, establishing a definition is likewise complex. In general however, boreal mixedwood forests are a mix of coniferous and deciduous trees. Typically, they occupy well-drained, fertile soils on mid-slope locations. The principal species include white spruce, black spruce, balsam fir, trembling aspen and white birch.

The BMW legacy

Earlier in Ontario's history, the conifer component of mixedwood forests was more marketable than the hardwood component. This led to extensive removal of the conifer overstory, which dramatically affected succession (the natural progression of vegetation on a site after a disturbance).

"The area of mixedwood cover types in northern Ontario is increasing as harvesting operations remove conifers and create conditions that favour early successional species such as trembling aspen, " comments Blake MacDonald, lead research scientist for OFRI's Boreal Mixedwood Silviculture Program. "This trend persists, despite past attempts to establish conifer monocultures after harvesting. Efforts to constrain renewal costs by government and industry in Ontario are leading to a greater reliance on natural regeneration. This type of extensive silviculture promotes mixed-species stands."

Traditionally, Ontario's policies, practices and information bases have not adequately supported sustainable mixedwood management, but the Class Environmental Assessment for Timber Management on Crown Lands in Ontario (1994) directed MNR to develop new silvicultural guidelines.

BMW comes into its own

Since spruce and pine are still prized for high quality pulp and lumber products, the challenge is to determine how to regenerate conifers while still maintaining the species diversity required for other timber and non-timber values.

Trends that have generated research interest in the BMW forest include:

- the Ontario government's shift to implementing sustainable forest management practices that promote biological diversity
- data that shows a loss of conifer from mixedwood sites
- increasing public concern around clearcutting and species' monocultures
- a global trend to certify commercial wood products to ensure they are derived from sustainably managed resources
- advanced technology in northern Ontario mills that uses hardwood for veneer and products such as oriented strandboard. For instance, trembling aspen, once described as a 'weed', is now in high demand by industry

"Ten years ago, when we were only manufacturing veneer, we normally used 10 to 30% of the aspen on the site," says Gordon King, company forester for Norbord Industries of Cochrane, Ontario. "The trees had to have a wider diameter, be straight and free of rot. Now that we also produce oriented strandboard, we use 70 to 90%, and we can use much smaller, less uniform trees."

Where to start?

A needs assessment conducted in 1994 by OFRI's Mixedwood Silviculture Program surveyed

stakeholders in the mixedwood forest. Research priorities include the examination of:

- silvicultural practices that favour natural regeneration
- site preparation techniques that mimic natural disturbances
- ecosystem impacts of alternative harvesting practices
- ecosystem structure and function, biodiversity and species interactions
- enhancement of non-timber values and forest-level wood supply
- classification of BMW sites using the Forest Ecosystem Classification (FEC) system
- compiling an inventory of the boreal mixedwood resource at a landscape scale
- growth and yield of understory trees over a 20-year span
- reducing regeneration costs to offset the increased cost of modified harvesting

'Careful logging' and partial cutting techniques have substantially reduced our tree planting investment," says Rod Gemmell, senior forester with Abitibi-Price, Inc. "We find there is a lot of post-harvest natural regeneration. We're in a transition period between artificial and natural regeneration, but where we used to spend $6M annually preparing sites and planting seedlings, we now spend $2.5M. Besides, by mimicking natural processes to release the conifer understory, we may be able to have harvestable trees 10 years earlier because the trees are already established in the forest."

Getting the answers

The Boreal Mixedwood Silviculture Program examines the abundance, diversity and relative position of component species at each successional stage. These stages depend on the previous disturbance type and the composition of the pre-disturbance stand.

"It's hard to improve on nature," explains Blake MacDonald. "Rather than fighting the natural succession of vegetation, the new philosophy is to work with successional trends and steer them towards the target stand structure set by the resource manager. Our goal is to produce new scientific knowledge to guide the development of ecosystem-based silvicultural practices for boreal mixedwood forests."

One project measures the impacts of different harvesting practices on BMW sites. Research is comparing the effects of removing 0%, 36%, 68%, or 100% of the mature trees on natural regeneration, successional patterns and diversity of vegetation, microclimate, and seed production.

Residual trees, regeneration, and all species of understory vegetation are measured annually. All trees are mapped to provide data for computer models of stand development.

Vertical fisheye images of the forest canopy are recorded annually to track changes in stand structure following different harvesting treatments.

'Careful logging' was completed in 1995 by project partners Norbord and Abitibi-Price, using methods that protected understory conifers and uncut trees. Winter harvesting took advantage of snow cover and frozen ground to protect the soil and young trees.

How will this research help resource managers?

Early results indicate that the 68% cut is economically acceptable. There is minimal damage to residual and understory trees from logging and windthrow. This treatment creates a desirable structure and microclimate for the conifer understory. Once sufficient conifer regeneration is established, the residual overstory can be removed or left for wildlife habitat and other values.

Information from these projects and from other contributors will be documented in the *Boreal Mixedwood Notes*. The binder format will accommodate fact sheets and

technical notes that are updated or added on an annual basis. The *Notes* will help forest managers to develop site specific silvicultural ground rules for the BMW sites in their area by:

- describing the successional changes to boreal mixedwood site types under different disturbance regimes
- serving as a primary resource to industry staff who are assuming more direct responsibility for silviculture in Ontario
- addressing the information required to manage BMW forests on an ecosystem basis
- helping forest managers to set stand- and landscape-level management objectives

Once in place, the guiding principles for managing BMW forests will help forest managers to design management prescriptions for BMW stands that will meet timber and non-timber values, and comply with the sustainability standards set within the province.

Boreal Mixedwood notes are distributed annually in Ontario. For information regarding the *Notes*, contact Joe Churcher, (705) 945-5710. For more information about this research, contact Blake MacDonald, (705 946-2981, Ext. 223, e-mail macdonb@epo.gov.on.ca.

Research in the Regions

Partnerships with MNR regional staff (and many others!) are critical to the success of OFRI's many projects. Following is a sample of our current cooperative ventures.

Central

Season and Height of Cutting Dictate Effectiveness

By Lisa J. Buse, Andrée Morneault and Wayne Bell

Results of a study established in 1993/94 have resulted in changes to silvicultural practices in parts of central Ontario. Motor-manual cutting of hardwoods with brush saws or chainsaws is normally carried out in late fall at close to ground level, but, according to OFRI research scientist Wayne Bell, cutting higher on the stem during the summer greatly reduces the vigour of subsequent suckers.

Provincial in scope, this study has blocks in Temagami (established in cooperation with Temagami district and the South Central Science Section (SCSS), Espanola (established in cooperation with E.B. Eddy Forest Products Ltd. and SCSS), Timmins (established in cooperation with Timmins district and the Northeast Science and Technology Unit) and Thunder Bay. Cutting treatments were applied to trembling aspen in the fall (October - November), winter (February - March) and summer (June - July) at heights of <10 cm, 25 cm, 50 cm, 75 cm and 100 cm. (Winter cuts were restricted to 75 cm and 100 cm.) One replication of each treatment was established on each site. Uncut check plots also were included. Average initial aspen dimensions for each area varied (Table 1).

Second-year post-treatment results indicate that cut height dictates whether regrowth occurs from root suckers or basal sprouts. Higher cuts produce sprouts, lower cuts produce suckers. Says Bell,

"If your objective is to release the conifer component but manage the stand as a mixedwood; i.e., to maintain a merchantable poplar component, cut as low as possible to encourage root suckering. This should also minimize fungal infection (see below). If your objective is to remove the aspen from the stand; i.e., to maximize damage, cut higher."

Table 1. Average initial aspen dimensions in the season and height of cutting study.

Location	Density (#/ha)	Mean Height (cm)	Max. Height (cm)
Temagami	15,020	149	196
Espanola	14,000	166	237
Thunder Bay	11,850	289	376
Timmins	23,080	325	436

The number of stems following cutting is unaffected by timing or height of cutting, but vigour is reduced when stems are cut mid-summer at higher than 50 cm. Cutting below the first live branch is important. Andreé Morneault, South Central Sciences Section, North Bay, reports that

"stems cut below the first live branch showed signs of fungal infection from cutting height to ground level; however, fungal infection in stems that were cut above a live branch went from the cut to the live branch and stopped. Although 50 cm may be the optimum cutting height to reduce aspen regrowth, cutting should be lower if 50 cm is within the live crown."

North Bay district and E.B. Eddy Forest Products Ltd. have begun using the recommendations from preliminary results to cut in the summer at 50 cm. Two operational concerns were raised: the ergonomics of cutting at 50 cm, and operator safety with higher stumps. The former can be addressed by adjusting the straps on the brushsaws to balance at the new height; the latter by changing the movement of the operators across the site.

Results from this study will feed into provincial policy related to using cutting treatments in vegetation management operations.

Andrée Morneault checks the summer 1m cut height at the Temagami site.

For more information, contact Wayne Bell (Phone: 705-946-2981 Ext. 198; e-mail: bellwa@epo.gov.on.ca) or Andreé Morneault (Phone: 705-475-5566; e-mail: morneaan@epo.gov.on.ca.).

Northeast

'Super' Trees, Super Fast

By Jocelyn Watt

For the first time in Ontario, second generation progeny bred from first generation 'plus' trees will undergo state-of-the-art genetic testing in a pilot project designed to deliver superior breeding stock for jack pine seed orchards; and in far less time than previous programs. Dennis Joyce, who leads OFRI's Genetic Resource Management (GRM) Program, has partnered with the forest industry-led Northeast Seed Management Association (NESMA) to provide scientific and technical support to the province's first ***advanced generation breeding*** (AGB) venture. In a push to improve productivity of the commercial land base, the pilot was established in the summer of '96, in provincial Seed Zone 22 between Chapleau and Kapuskasing. In keeping with GRM principles, gene conservation concerns are built into the economic objectives of the tree improvement program.

What is AGB and how can it advance forest management in Ontario?

Over the past few years, tree improvement efforts in Ontario have been revitalized through the establishment of an association of operational co-operatives, the Ontario Tree Improvement Board (OTIB), of which NESMA is a member. AGB is a tree breeding strategy that draws on recent scientific innovations to develop genetically superior populations faster than previous methods, vastly improving the efficiency and economics of tree improvement.

Tree breeding efforts strive to optimize those genetic gains that are important to commercial interests. This means significant gains in growth rate and stem form while maintaining or improving wood quality. The optimum strategy will realize maximum gain while maintaining a bottomline investment in time and money.

"Tree improvement allows industry to capture a larger volume from the same land base, or perhaps the same volume from a smaller land base," explains Joyce. "It's a matter of more gain, faster. Parent trees of first generation progeny were selected from the wild forest by a system based on visual criteria. Progeny from selected trees undergo testing to determine which are genetically superior."

First generation programs are delivering between 5% and 8% improvement in growth rate. In the fall of 1996, 350 trees were selected for second generation breeding. This second generation program could deliver up to 15% improved growth rate over the first generation.

A second generation could have as much as a 20% improvement over the 'wild' parent, and a third generation could provide another 15% improvement. Thus, if jack pine seedlings planted now are averaging 30 cm of height growth per year over the first 5 years, then third generation stock would average 40 cm per year.

How is AGB innovative?

Selection

To achieve second generation goals, data collected over a 15-year period must be analysed to rank approximately 2,700 trees. Ranking is based on a synthesis of height and stem quality data.

"Ranking is a daunting task,"continues Joyce. "Frank Schnekenburger (GRM's data analyst) 'works his magic' and uses an index selection, which involves weighing genetic information on multiple traits to rank candidate trees. This allows us to maximize our gain per unit of information."

Testing

Since the early '80s, 27 jack pine seed orchards have been established in Ontario. Traditionally 'field performance' tests are established in operational clearcuts and measured over a 15- to 20-year period. The limitations of this kind of testing include low precision while seedlings are getting established in their early years, variable test precision at later stages, and an emphasis on long-term results. Research to establish higher precision, short-term testing procedures has resulted in what are referred to as 'farm-field' tests.

Farm-field testing focuses on generating high quality information about genetic potential between the ages of 5 and 10 years, compared to the traditional 20 years. Farm-field testing is based on selecting a site that fosters vigorous growth. The design emphasizes close initial spacing and the ability to conduct thinnings as trees grow larger. Damaged trees are not included in the analysis. Practicing 'clean cultivation' minimizes random environmental effects and vastly improves the reading of genetic potential.

"If we can double the genetic potential by improved testing procedures," says Joyce, "we can double the gain."

Seed orchards

Final measurements in farm-field tests will be taken within 10 years. Consequently, farm-field tests can be converted directly into seed orchards; a real time and dollar saver, compared to the traditional practice of establishing separate orchards once testing is completed.

Over the next 5 years, information compiled from the pilot project will be used to guide other operational programs that will be able to establish a nucleus breeding system that focuses limited resources on the best genetic material, and farm field-testing guidelines that support the evaluation of realized tree improvement gains.

For information, contact Dennis Joyce (Ext. 215, E-mail: joycede@epo.gov.on.ca) or Frank Schnekenburger (Ext. 216; E-mail: schnecfr@epo.gov.on.ca).

OFRI scientist wins Amethyst

Dr. Steven Colombo, Tree Stress Research Scientist at OFRI, received the Amethyst Award for Outstanding Achievement at a special awards ceremony held in Toronto on December 5th.

This award recognizes individuals in the Ontario Public Service who have made exceptional contributions in the areas of professional leadership, innovation and client service.

"Steve has never lost sight of the importance of moving science and technology out of the laboratory and into the public domain," says

Dr. Gary Ritchie, Senior Scientist for Weyerhauser Co.

Since Steve joined the MNR in 1980, nursery managers and field foresters in Ontario and abroad have come to rely on his expertise to help them meet the on-going challenges of forest regeneration.

As Dr. Dave DeYoe, OFRI's General Manager points out, "The operational successes of Frost Hardiness Testing Laboratories, the Stock Quality Assessment Program and the innovative approaches of extended greenhouse culture and of field-portable assessment tools would not be possible without Steve's efforts."

Steve has extended the boundaries of science by publishing over 25 peer-review and 47 technical articles, as well as co-editing an upcoming book titled *Regenerating Ontario's Forests.*

Northwest
Growth and Yield Modelling Toolkit Being Developed

by Lisa J. Buse, Voytech Zakrzewski, and Jim Mackenzie

Forestry consultants and contractors who supply timber inventory data collection and survey services to resource managers will soon have a new tool that will make their job easier.

"In the past, data collected from Ontario's forests have often remained as numbers rather than being developed into information or tools for resource managers. In 1993, the Forest Ecosystem Productivity Modelling (FEPM) Project was established at OFRI to develop a Growth and Yield Forest Modelling Framework for Ontario (FRONT). The goal of this program is to turn all of the available growth and yield data in Ontario into information and tools to help forest resource managers make sound management decisions," explains OFRI scientist Voytech Zakrzewski.

FRONT

The *Growth and Yield Modelling Framework* (called FRONT) consists of a series of modules that will generate growth and yield information for a range of spatial and temporal scales. FRONT can be described as: a computerized library of growth and yield applications, a provincial system to process monitoring data, and a set of research projects that support a range of growth and yield applications. Zakrzewski is quick to emphasize the cooperation with the growth and yield specialists at the Regional Science and Technology Units. Jim Mackenzie, Northwest Science and Technology, explains: "Regional and district staff establish and measure permanent sample plots across the province. This data supplements the modelling databank."

FRONT's modules

FRONT is a library of models, methods and procedures grouped within 2 modules that differ in temporal scale:

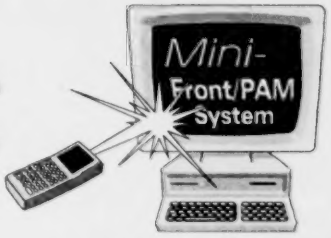
1) ASSESS: provides a static assessment of forest yield and evaluates current stand structure; and

2) PROJECT: provides a dynamic projection of forest yield.

A third module ACCESS DATA, which stores statistics about geographically identified forest units, allows access to the databank. This module can be used to access (filter or read) stand-specific field measurement files for a user-specified purpose, e.g., model refinement or monitoring compilations. This module can also be used to read forest inventory records (FRI) and update them with current results from the ASSESS module, or apply them to the projection tools from the PROJECT module.

These 3 modules supply information at the forest scale; however, in many situations it is more useful to be able to apply these tools at a much smaller scale; e.g., township or stand. For this reason, subcomponents (systems) are being developed that can be used as stand-alone tools.

Currently, 2 timber inventory systems have been developed within the ASSESS module. The software was developed for electronic data capture devices, e.g. DAP. Supporting documentation and technical support are included.



Mini-FRONT/PAM system

The Mini-FRONT/PAM system is designed to facilitate timber inventory procedures. It displays stand volume and its error estimate directly in the field and generates data collection/ survey reports in the office. The systems consists of:

1) PAM (Plot Assessment and Modelling) software, which provides guidance for field data collection and produces digital field measurements.

2) Mini-FRONT, which is a PC-based timber inventory data compiler and report generator for data editing and yield assessment. Volume and error estimates can be viewed on the screen or printed either at the plot or stand-level. Final estimates can be presented in graphs or tables.

MIXONT/SEM system

Although the MIXONT/SEM system is part of the ASSESS module, it has some dynamic features. It is both a silvicultural decision-support system for multi-age tolerant hardwood-dominated stands and a timber inventory tool designed for use in Southcentral Ontario. It consists of:

1) SEM (Stand Evaluation and Modelling) software, which provides guidance for field data collection and estimates and errors of measured stand characteristics in the field.

2) MIXONT, which is a PC-based data compiler and report generator for data editing and assessment of: yield (timber volume, number of 8-foot logs), stocking, tree quality, regeneration status, and wildlife value. Stand structure is evaluated by comparing actual tree biomass distribution with a hypothetical optimum. Tree removal simulations help users to choose a harvesting scenario.

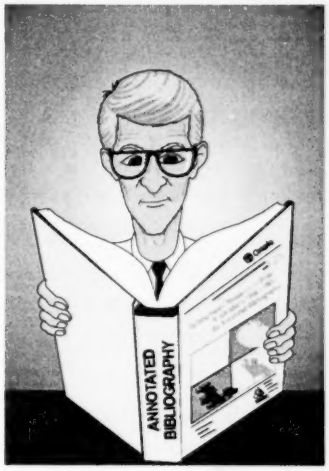
Future

Prototypes of the modules have been tested and a user manual is being developed along with additional modules. The software is scheduled for release in the spring of 1997.

For more information, contact Voytech Zakrzewski (Phone: 416-978-4638, e-mail: zakrzev@mnr.gov.on.ca).

1990-1995 Annotated Bibliography

An annotated bibliography of OFRI publications over the 5-year period 1990 to 1995 is available. The bibliography includes highlights of journal articles, research reports, information papers, technical notes, and newsletters produced by OFRI authors under MNR's Sustainable Forestry Initiative. To receive a copy, contact OFRI's publication request line at 705-946-2981 Ext. 269.



Have a suggestion? Want more information on a research project? We want to hear from you!

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Upcoming Events

LUSTR Co-op AGM (Annual Growers' Meeting) and Workshop. Sault Ste. Marie, Ontario. Jan. 8-10, 1997. Contact: Dr. Irwin Smith, Tel: (807) 623-1397.

Ontario Professional Foresters Association Annual Meeting, Sault Ste. Marie, Ontario. Feb. 19-22, 1997. Contact: Richard MacNaughton R.P.F. (705) 759-5740 ext. 2277. Exhibits: Dan Cooligan, R.P.F. (705) 945-5854

Sustainable Site Productivity in Canadian Forests. Sault Ste. Marie, Ontario. Feb. 18-20, 1997. Contact: Guy Smith, Canadian Forest Service (705) 759-5740 ext. 2165.